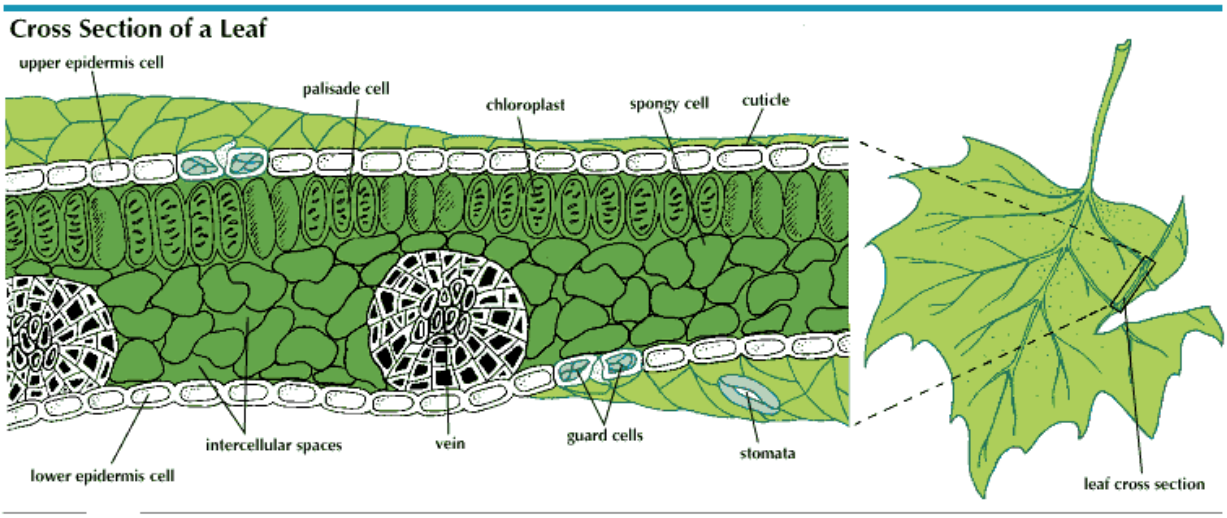
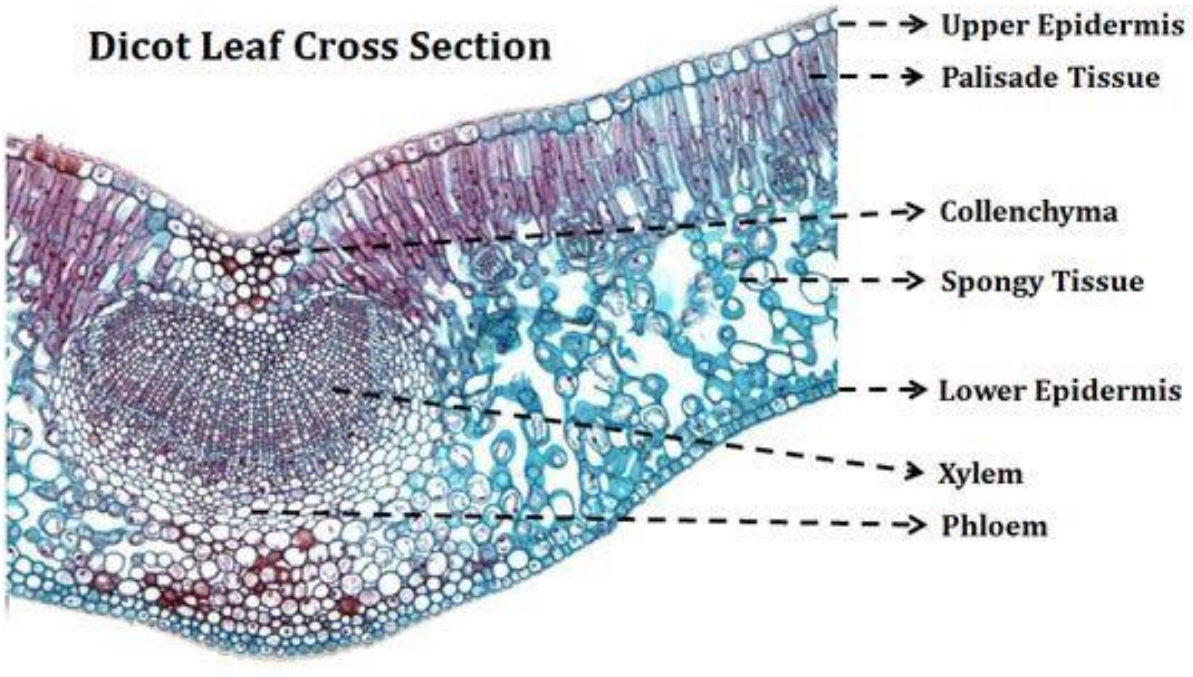
LO: Identify and label the cellular and tissue structure of a dicotyledonous leaf, as seen in transverse section using the light microscope and describe the significance of these features in terms of their functions, such as the

- ***distribution of chloroplasts in photosynthesis***
- ***stomata and mesophyll cells in gaseous exchange***
- ***vascular bundles in transport***

Internal leaf Structure





Structure	Function
Upper epidermis	● Contains cuticle (waxy layer that reduces excessive evaporation of water) ● Single, protective layer of cells ● Transparent to allow light to pass through to reach the mesophyll cells ● No chloroplasts
Palisade Mesophyll cells	● Closely packed, large number of chloroplasts to absorb maximum light energy for photosynthesis.
Spongy Mesophyll cells	● Lesser chloroplasts for photosynthesis ● Loosely packed with intercellular air spaces to facilitate diffusion of carbon dioxide and water vapour ● Surface covered with layer of moisture to allow carbon dioxide to dissolve first before diffusing into cells
Vascular bundles (xylem + phloem)	**Xylem** ● Transports water and minerals salts from roots to leaves ● Strengthens leaf to prevent tearing **Phloem** ● Transports sucrose and amino acids from leaves to other parts of plant (Translocation)
Lower epidermis	● Single, protective layer of cells ● Presence of stomata for gaseous exchange
Guard Cells	● Regulate the opening and closing of the stomata ● Contain chloroplasts for photosynthesis

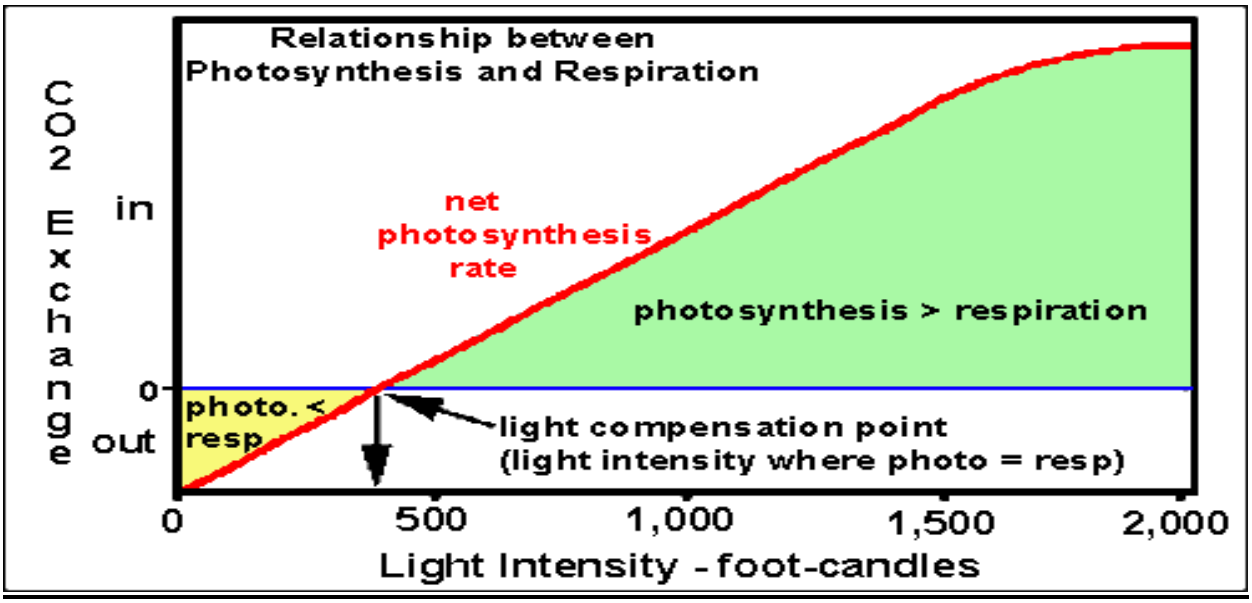
LO: State the equation, in words and symbols, for photosynthesis

Word Equation:

carbon dioxide + water $\xrightarrow[\text{chlorophyll}]{\text{light energy}}$ glucose + oxygen

Chemical Equation:

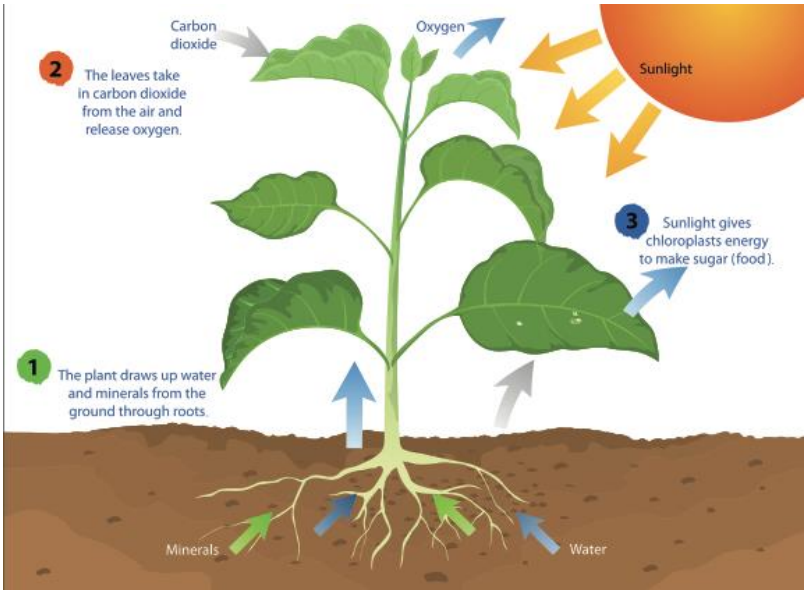
$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{light energy}} C_6H_{12}O_6 + 6O_2$



- Rate of respiration in plants is taken to be <u>constant</u>.
- When rate of photosynthesis is <u>higher</u> than rate of respiration, net carbon dioxide is <u>taken in</u>.
- When rate of photosynthesis is <u>lower</u> than rate of respiration, net carbon dioxide is <u>given out</u>.

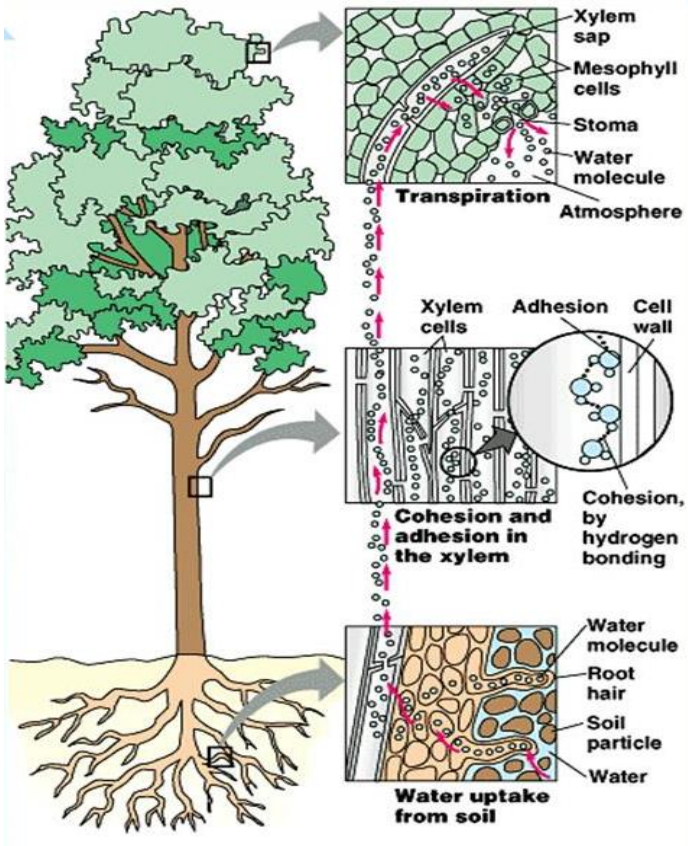
LO: Describe the intake of carbon dioxide and water by plants

Entry of carbon dioxide through the leaves of the plant



- Enters the leaves through the stomata from the surrounding atmosphere
- By diffusion down a concentration gradient (higher concentration in the atmosphere than in the inside of the leaves)
- Moves into the intercellular air spaces
- Dissolves in the film of moisture surrounding the mesophyll cells
- Diffuse into the chloroplasts of the mesophyll cells

Entry of Water through the roots of the plant



From the roots

- Enters root hair cells from the soil
- By osmosis down the water potential gradient (higher water potential in the soil than the cell sap of the root hair cells)
- Moves from cell to cell, via osmosis until it reaches the xylem
- Root pressure moves water from cells into the xylem

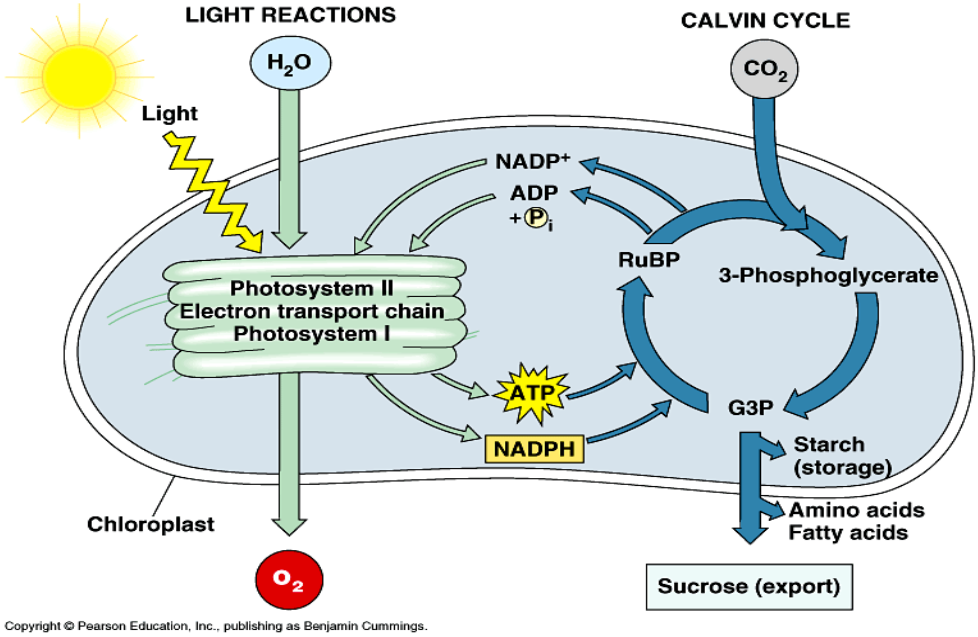
Up the xylem

- Water moves up the xylem from the roots to the leaf by
  - root pressure
  - cohesion and adhesion of water molecules through capillary action
  - transpiration pull

In the leaf

- Water moves out of xylem and moves from cell to cell, via osmosis until it reaches the mesophyll cells

LO: State that chlorophyll traps light energy and converts it into chemical energy for the formation of carbohydrates and their subsequent uses



- Chlorophyll absorbs light energy from the sun and converts it into chemical energy for the formation of glucose in photosynthesis.

In the light **dependent** stage:

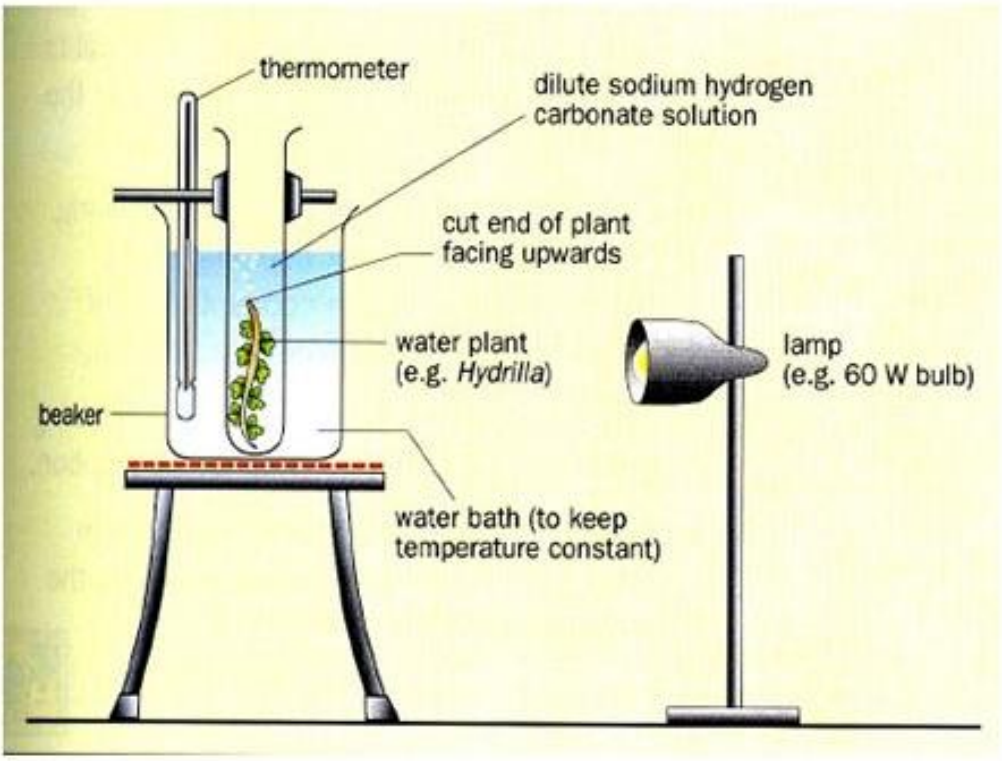
- Light energy is absorbed by chlorophyll and then converted into chemical energy.
- Light energy is used to split water molecules into oxygen and hydrogen atoms through photolysis of water.

In the light **independent** stage:

- Hydrogen atoms (from the photolysis of water), chemical energy (from light dependent stage) and enzymes are used to reduce carbon dioxide to glucose.
- Glucose formed is used for respiration and formation of cellulose cell walls.
- Glucose is converted to sucrose and transported to storage organs via translocation.
- Excess glucose is stored as starch or fats, and converted into proteins to form new protoplasm.

LO: Investigate and discuss the effects of varying light intensity, carbon dioxide concentration and temperature on the rate of photosynthesis (e.g. in submerged aquatic plant)

Experimental set-up to investigate factors affecting rate of photosynthesis



Factors affecting rate of photosynthesis:

Light intensity

- vary the distance of light source from the plant
- As light intensity increases, rate of photosynthesis increases.

Carbon dioxide concentration

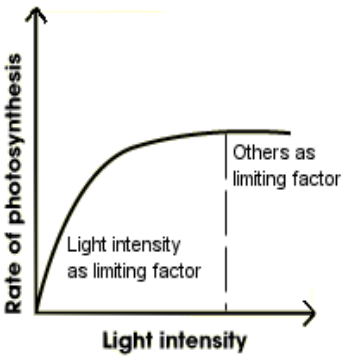
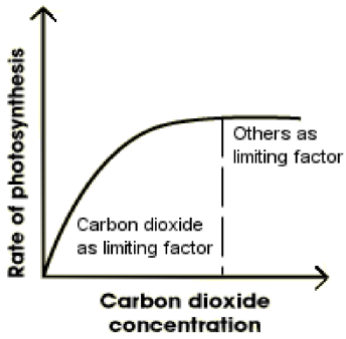
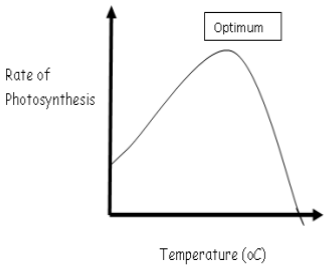
- vary the concentration of dilute sodium hydrogen carbonate solution
- As carbon dioxide concentration increases, rate of photosynthesis increases.

Temperature

- vary the temperature of the water bath
- As temperature increases, rate of photosynthesis increases until optimum temperature is reached. Increased in temperature beyond the optimum temperature causes enzymes to be denatured and rate of photosynthesis decreases.

LO: Discuss light intensity, carbon dioxide concentration and temperature as limiting factors on the rate of photosynthesis

- A factor that directly affects or limits a process if its quantity or concentration is altered is called a **limiting factor**.

	• As light intensity increases, stomata opens wider • More carbon dioxide can diffuse into the plant through the stomata • Rate of photosynthesis increases
	• As concentration of carbon dioxide increases, more carbon dioxide can diffuse into the plant through the stomata • Rate of photosynthesis increases
	• As temperature increases, enzymes and substrates have higher kinetic energy, hence higher frequency of effective collisions • Rate of formation of enzyme substrate complex increases • Rate of photosynthesis increases • Beyond optimum temperature, rate of photosynthesis decreases as enzymes are denatured